SANTA CLARA VALLEY WATER DISTRICT

(DRAFT)

1981

HYDROLOGY

Addendum to 1976 Ross Creek

Hydrology Study

Prepared by

A. D. Saah

Under the Direction of

John L. Richardson
Head, Project Development Branch
Flood Control

and

George S. Korbay
Flood Control Manager

GB
1025
R67.S2
1981
c.1
LIBRARY

DISTRICT BOARD OF DIRECTORS

Arthur T. Pfeiffer, Vice Chairman	District 1	James J. Lenihan, Chairman	District 5
Patrick T. Ferraro	District 2	Sig Sanchez	At Large
Robert W. Gross	District 3	Linda Peralta	At Large
Maurice E. Dullea	District 4		

57R944tp

GB1625R67S2 1981 c.1

SANTA CLARA VALLEY WATER DISTRICT

(DRAFT)

1981

HYDROLOGY

Addendum to 1976 Ross Creek
Hydrology Study

Prepared by

A. D. Saah

Under the Direction of

John L. Richardson
Head, Project Development Branch
Flood Control

and

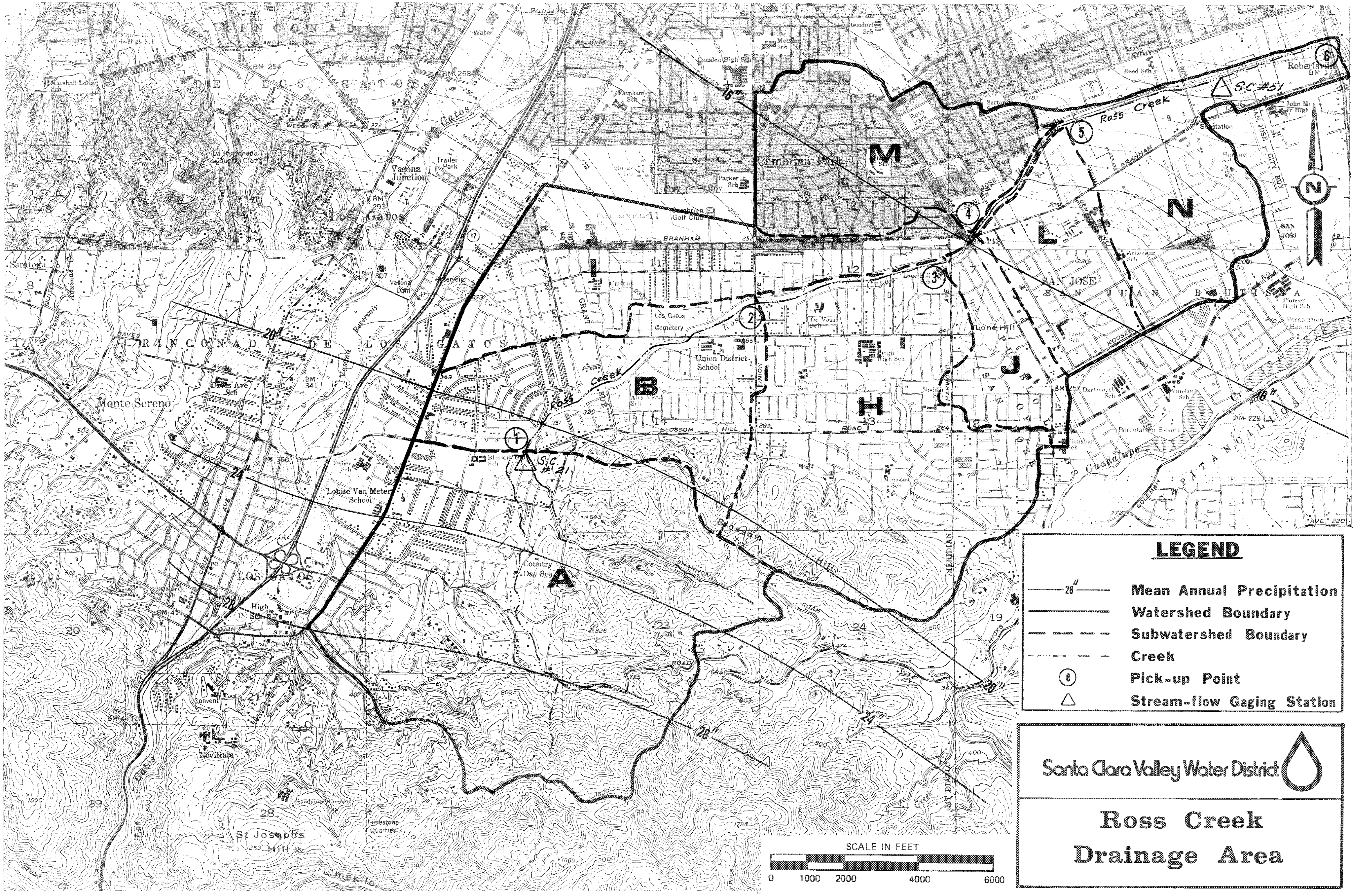
George S. Korbay
Flood Control Manager

SANTA CLARA VALLEY WATER DISTRICT
LIBRARY
5750 ALMADEN EXPRESSWAY
SAN JOSE, CALIFORNIA 95118

DISTRICT BOARD OF DIRECTORS

Arthur T. Pfeiffer, Vice Chairman	District 1	James J. Lenihan, Chairman	District 5
Patrick T. Ferraro	District 2	Sig Sanchez	At Large
Robert W. Gross	District 3	Linda Peralta	At Large
Maurice E. Dullea	District 4		

57R944tp



LEGEND

—28"—	**Mean Annual Precipitation**
———	**Watershed Boundary**
— — —	**Subwatershed Boundary**
—·—·—	**Creek**
⑧	**Pick-up Point**
△	**Stream-flow Gaging Station**

Santa Clara Valley Water District

Ross Creek Drainage Area

General

This study was authorized to check the previous work (done in 1976) and incorporate in the determination of design flows, the up-to-date runoff data collected at Stations 21 - Ross Creek at Blossom Hill Road and 51 - Ross Creek at Cherry Avenue. The use of the 1976 urban hydrology method and Regional Regression Equations are continued in this study, together with the use of the Clark's Synthetic Unit hydrograph. This study is more site specific in applying the urban hydrology method. Some assumptions, like streets overbanking into the creeks, and overland flow in areas B and H are considered.

Table 1 is a comparison of the previous design flows and the present ones at the two locations of the gaging stations:

TABLE 1
Final Design Flow Values
1981 Study

Location	1%		10%	
	1976 Flows cfs	1981 Flows cfs	1976 Flows cfs	1981 Flows cfs
Station 21	1100	1170	520	585
Station 51	1950	2220	1128	1500

It is obvious from the above table that the design flows did not change significantly at Station 21, while a slight increase happened at Station 51. This increase could be attributed to the inclusion of the high flows of the 1978, 1979 and 1980.

The following is a detailed description of the work done.

Basic Data and Loss Rates

The annual streamflow data at Station 21 were checked and found satisfactory. At Station 51, though, the recorded channel's peak flows (excluding overbanking) of January 1968 (1550 cfs), January 1978 (1502 cfs) and February 1980 (1600 cfs) were thought to be overestimated because the capacity of the culvert underneath Jarvis Road was calculated to be 1200 cfs (Ross Creek, Preliminary Report, February 1980). To check that, a reconstitution of the February 1980 flood from rainfall was attempted. Starting with a recorded hydrograph that has a peak flow of 1200 cfs at Station 51, and assuming no constriction upstream, this reconstitution of the February 1980 storm-flood proved that there was a potential of having a 1600 cfs as an unimpaired peak flow at Cherry Avenue. This value is similar to the recorded flow. For that reason, the peak flows shown in the record were used for the frequency analyses by assuming that they represent the natural channel condition without constrictions.

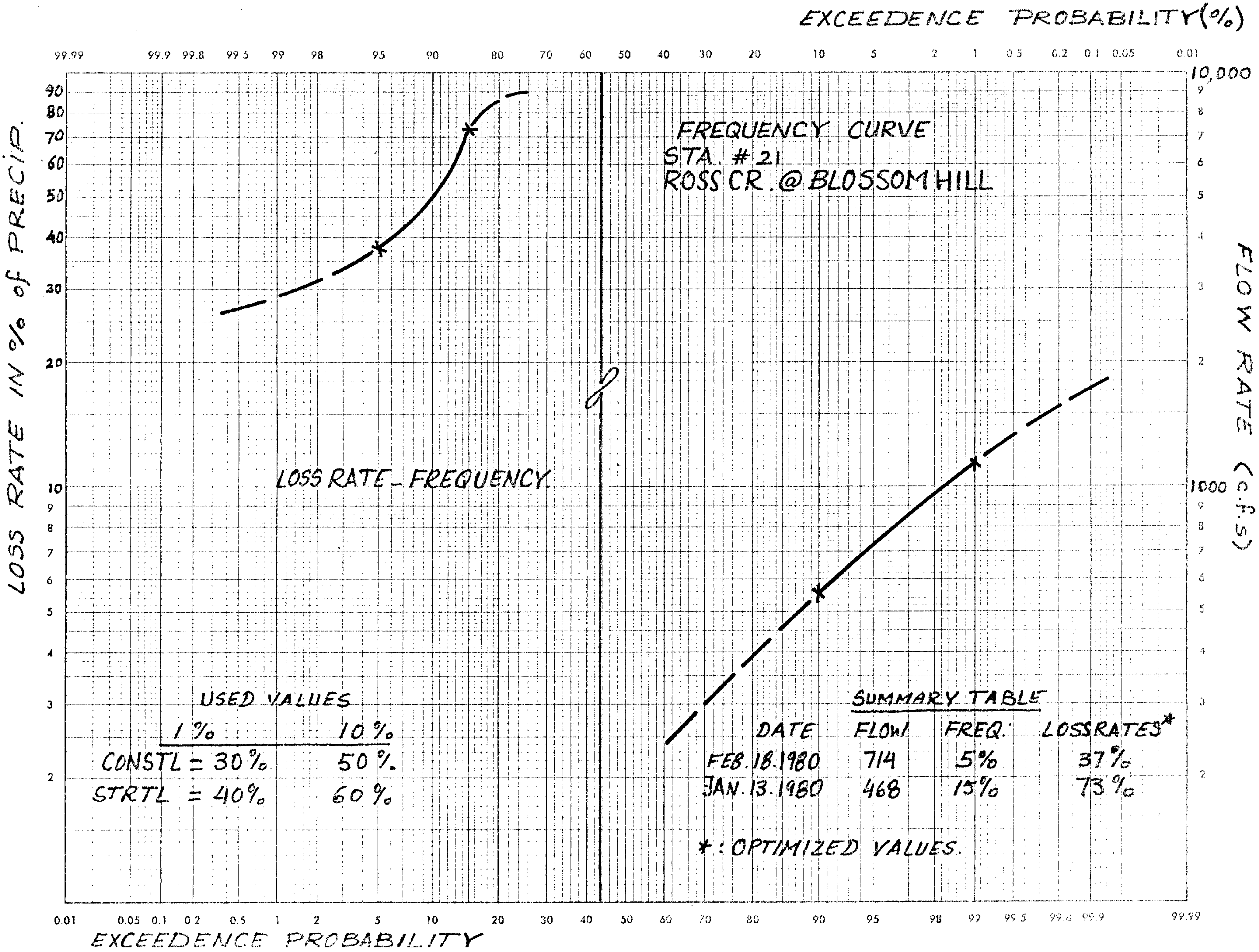
Loss rate functions for the two streamflow Stations 21 (representing a rural area) and 51 (urban and rural) were optimized using average rainfall (from precipitation Stations 36, 42, 79 and 125) and recorded streamflow data for the January and February 1980 storms. At Station 51, the results of this optimization were not used because of the mixed nature of the watershed. At Station 21, this optimization generated loss rates for the rural and, hence, the pervious parts of the watershed. It was found that the peak flow of the January flood (470 cfs) had a frequency of occurrence of 15 percent and the February flood (714 cfs) had a frequency of five percent. The loss rates for those floods were 73 percent and 37 percent respectively. Plotting the frequency-loss rates on a log probability paper resulted in an approximate 1% design loss rate of 30 percent, and 10 percent design loss rate of 50 percent of the total 24-hour precipitation. Figure 1 is a graphical representation of above values.

The above design loss rates where used as a guide. Other parameters, like the synthetic unit hydrograph variables, were calibrated to reproduce applicable regional or recorded data in rural areas A and H_2.

Frequency Analyses

Tables 2 and 3 show a listing of the recorded (unimpaired) flows at Stations 21 and 51, together with the frequency analyses of such data.

FIG 1



USED VALUES

	1 %	10 %
CONSTL =	30%	50 %
STRTL =	40%	60 %

SUMMARY TABLE

DATE	FLOW	FREQ.	LOSSRATES*
FEB. 18. 1980	714	5%	37%
JAN. 13. 1980	468	15%	73%

*: OPTIMIZED VALUES.

Table-2

```
                                                                  FLOOD FLOW FREQUENCY COMPUTA

                                                               BSCVWD STA.#21-ROSS CREEK * F
                                                 N       NQH     NOUTL      IYRA     IPLOT     IEXPP
                                                35         0         0         0         1         0

FINAL RESULTS
                                    water
             DAY        MONTH       YEAR        FLOW     ORDERED          RANK    PLOT POS
             22           12        1945        140.      1068.             1      0.0278
             12            2        1947         21.       850.             2      0.0556
             29            4        1948         20.       714.             3      0.0833
             11            3        1949        110.       570.             4      0.1111
              5            2        1950         42.       480.             5      0.1389
              8           12        1950        133.       396.             6      0.1667
             14            3        1952        209.       392.             7      0.1944
              7           12        1952         62.       390.             8      0.2222
             13            2        1954         98.       370.             9      0.2500
             18            1        1955         85.       369.            10      0.2778
             22           12        1955        850.       330.            11      0.3056
             24            2        1957         78.       305.            12      0.3333
              2            4        1958        480.       299.            13      0.3611
             16            2        1959        305.       233.            14      0.3889
              1            2        1960        117.       214.            15      0.4167
              1           12        1960         90.       209.            16      0.4444
             22            2        1962        214.       200.            17      0.4722
             31            1        1963        330.       158.            18      0.5000
             20            1        1964        370.       140.            19      0.5278
             10            1        1964        200.       137.            20      0.5556
             29            1        1966        110.       133.            21      0.5833
             24            1        1967        396.       117.            22      0.6111
             30            1        1968        570.       110.            23      0.6389
             26            1        1969        390.       110.            24      0.6667
              1            3        1970        299.        98.            25      0.6944
              1           12        1970        369.        90.            26      0.7222
             27           12        1971         46.        85.            27      0.7500
             16            1        1973        233.        78.            28      0.7778
              3            1        1974        158.        62.            29      0.8056
              7            3        1975        137.        49.            30      0.8333
              2            3        1976         39.        46.            31      0.8611
              2            1        1977         49.        42.            32      0.8889
             14            1        1978       1068.✓       39.            33      0.9167
             15            1        1979        392. ←      21.            34      0.9444
             19            2        1980        714.✓       20.            35      0.9722

MEAN                    2.2134
STD DEV                 0.4404
COMPUTED SKEW          -0.2327
REGIONAL SKEW          -0.6000
ADOPTED SKEW           -0.5510

COMPUTED FLOW          PROBABILITY                        .05 LIMIT       .95 LIMIT
      1560.              0.002                               2967.            989.
      1322.              0.005                               2426.            856.
      1142.              0.010                               2031.            754.
       962.              0.020                               1652.            649.
```

```
[illegible]     0.040                      1294.      542.
  556.          0.100                       859.      399.
  390.          0.200                       567.      288.
  179.          0.500                       240.      135.
   72.          0.800                        98.       50.
   43.          0.900                        60.       27.
   27.          0.950                        40.       15.
   10.          0.990                        16.        5.
```

Continue
Table-2

Table-3

Table-3

```
                                                                   FLOOD FLOW FREQUENCY COMPUTA


                                                                   BSCVWD STA.#51- ROSS CREEK @

                                              N       NQH     NOUTL     IYRA     IPLOT     IEXPP
                                             22         0         0        0         1         0
```

FINAL RESULTS Excluding Jan. 24. 1960 flood (45c.f.s) — ?

```
              DAY       MONTH       YEAR        FLOW      ORDERED        RANK    PLOT POS
              24           2        1957        115.       1550.           1      0.0435
               2           4        1958        480.       1549.           2      0.0870
               1          12        1960        230.       1502.           3      0.1304
              14           2        1962        583.       1115.           4      0.1739
              31           1        1963        880.       1030.           5      0.2174
              20           1        1964        820.        952.           6      0.2609
              10          11        1964        850.        880.           7      0.3043
              28          12        1965        320.        850.           8      0.3478
              24           1        1967       1030. *      845.           9      0.3913
              30           1        1968       1550. *      820.          10      0.4348
              26           1        1969        845.        617.          11      0.4783
               1           3        1970        550.        583.          12      0.5217
               1          12        1970        952.        581.          13      0.5652
              27          12        1971        285.        550.          14      0.6087
              16           1        1973        581.        480.          15      0.6522
              30          11        1973        617.        465.          16      0.6957
               7           3        1975        465.        393.          17      0.7391
               2           3        1976        248.        320.          18      0.7826
               2           1        1977        393.        285.          19      0.8261
              14           1        1978       1502.        248.          20      0.8696
              15           1        1979       1115.        230.          21      0.9130
              19           2        1980       1549.        115.          22      0.9565

                                         *
      MEAN                    2.7769
      STD DEV                 0.2951
      COMPUTED SKEW          -0.6034
      REGIONAL SKEW          -0.6000
      ADOPTED SKEW           -0.6000


      COMPUTED FLOW          PROBABILITY                   .05 LIMIT        .95 LIMIT
            2612.               0.002                         4621.            1808.
            2355.               0.005                         4040.            1657.
            2147.               0.010                         3585.            1532.
            1925.               0.020                         3117.            1397.
            1690.               0.040                         2638.            1249.
            1352.               0.100                         1991.            1027.
            1071.               0.200                         1494.             832.
             640.               0.500                          823.             502.
             347.               0.800                          446.             251.
             243.               0.900                          323.             161.
             176.               0.950                          245.             107.
              92.               0.990                          142.              46.
```

At Station 21, the data were plentiful (34 years) and the analysis was simple and straightforward. At Station 51 (23 years) the December 1, 1960 peak flow (45 cfs), though not qualifying as a low outlier (per the WRC criteria), was found to be the reason for the excessive negative skewness of -1.23 (the regional skew is -0.6). At the same time, this peak flow was found to be the reason for the increased variability of the data (the standard deviation was equal to 0.37 when including the 45 cfs value and 0.29 when excluding it). Therefore, this peak flow was excluded from the frequency analysis.

At Station 51, the historical high water marks shown in pictures revealed that, during the 1978 flood (recorded peak = 1502 cfs), the channel was bank full and hardly spilling. For this reason the 1502 cfs value was replaced by an approximate value of 1300 cfs (maximum channel capacity plus overbanking) and the data set was reanalysed. The reanalysis resulted in a very little change in the design flow and, therefore, the originally recorded peak flow value of 1502, though not wholly accurate, was used in the final frequency analysis.

Regional Values

As part of utilizing the data from wherever available, the 1976 regional regression equations - applicable only to rural areas - were used to calculate flows for all subwatersheds. A good match was noticed at Station 21 while, at Station 51, the regional equations gave higher values.

Rainfall Generated Flows

The one percent and ten percent design storms were calculated using the SCVWD rainfall regression equations. A comparison of the results with design storm values obtained from the analysis of recorded data at nearby station (DWR Bulletin #195) proved the validity of the regression model. Using the Corps of Engineer program HEC-1, inflow hydrographs were generated from design storms. The loss rates were based on the analysis discussed early in this report. The synthetic unit hydrograph parameters were based on the travel time and watershed geometric configuration. In rural areas, those parameters were adjusted to match recorded or regional results.

In urban areas, the SCVWD urban hydrology method was used. The pervious and impervious parts were delineated for every subwatershed A_1, A_2, A_3, B, H_1, H_2, I, J, L, M and N. Subwatershed A_1, A_2 and H_1 were sparsely urbanized and, therefore, were considered rural and used to calibrate the runoff generated from rainfall with results from the regional regression equations and from streamflow records. As a result of that, the final choices of the time of concentration (Tc) and routing function (R), together with other hydrograph parameters, were made.

The rest of the subwatersheds were considered urban and subdivided further into pervious and impervious parts. The urban hydrology method was used to generate separate hydrographs from each part and combine them to obtain urban inflow. This inflow is then routed, by puls method, through a storage facility made of storm drains, manholes, catch basins, gutters and streets. The storage discharge relationship shown in Figure 2 is used for this operation. An alternative run (no route) was made without the puls routing through the storm drains.

Discussion of Results and Conclusions

Based on the above, four flow values were obtained; 1) based on the statistical analysis of recorded data, 2) based on the application of the regional regression equation, 3) produced from rainfall after routing through the storm drains (route) and 4) produced from rainfall without routing through storm drains (no route). Figures 3 and 4 are graphical representation of the frequency regemes at the location of the two gaging Stations 21 and 51 for each of the four methods.

At Station 21, a good match of results from all methods was obtained, while at Station 51 the effect of urbanization is demonstrated by the difference between those graphs.

The similarity of those results at Station 21 proves the applicability of our hydrologic parameters to rural areas and, hence, the pervious parts of the watershed.

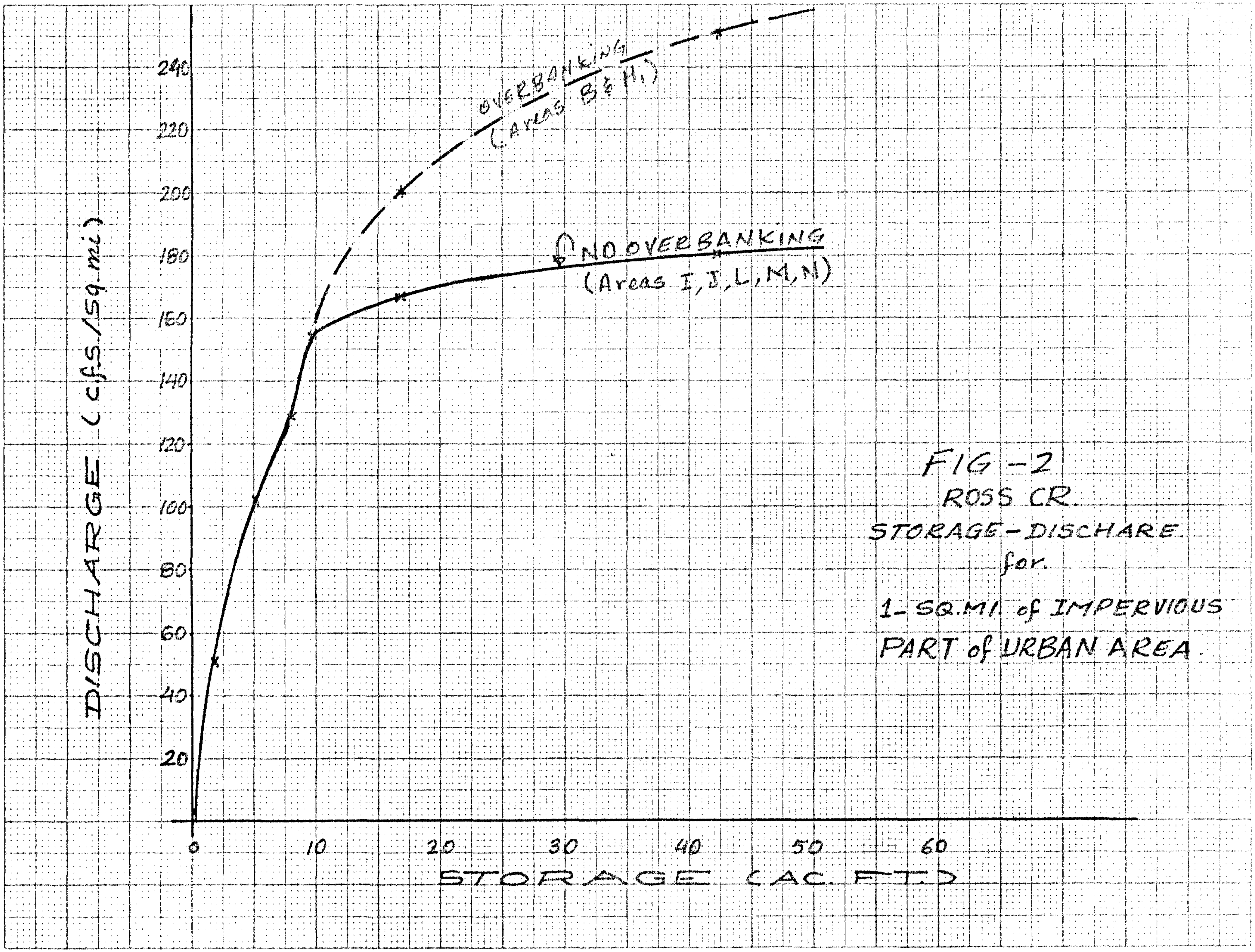


FIG -2
ROSS CR.
STORAGE-DISCHARE
for
1-SQ.MI. of IMPERVIOUS
PART of URBAN AREA.

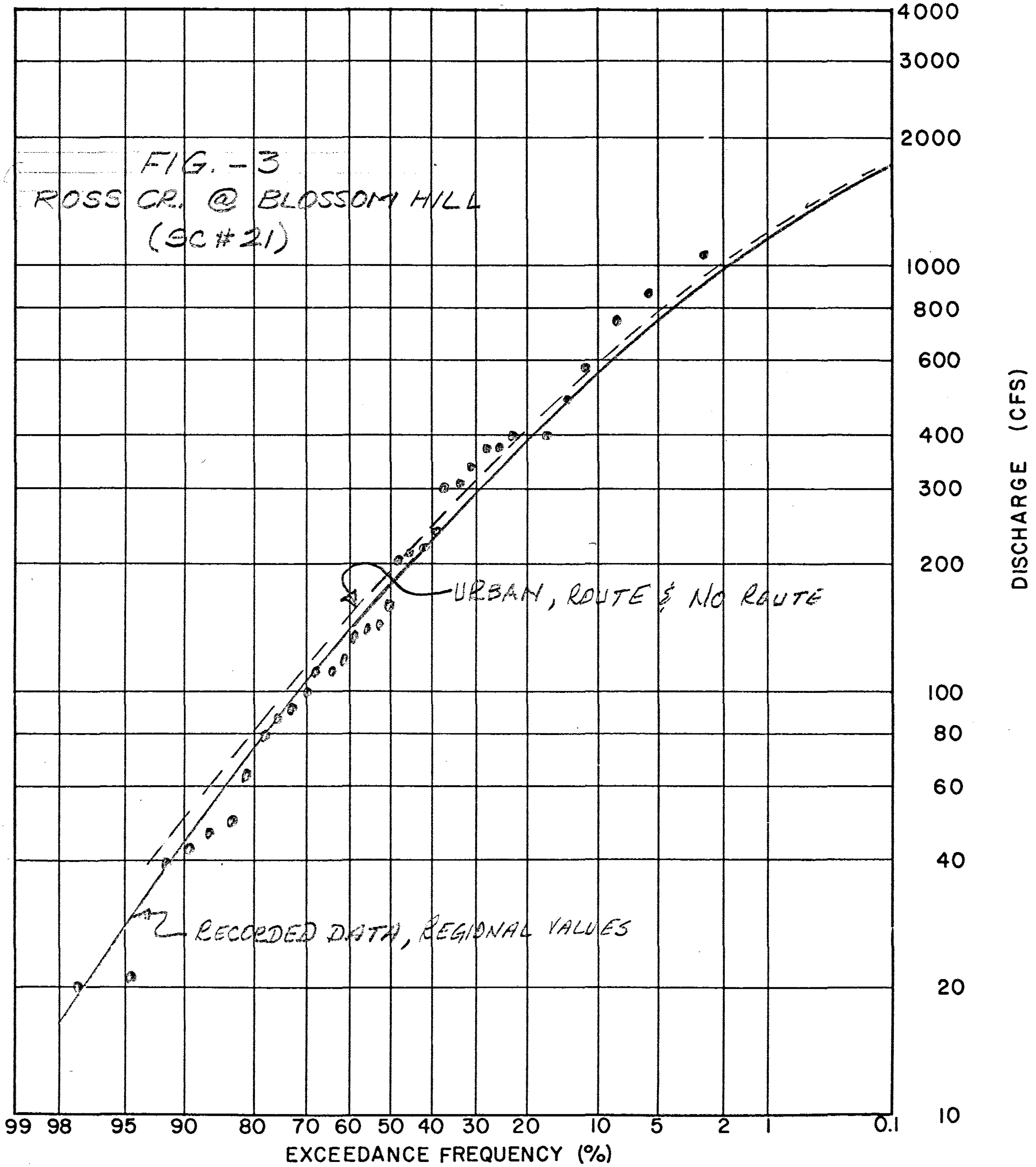


FIG. -3
ROSS CR. @ BLOSSOM HILL
(SC#21)

URBAN, ROUTE & NO ROUTE

RECORDED DATA, REGIONAL VALUES

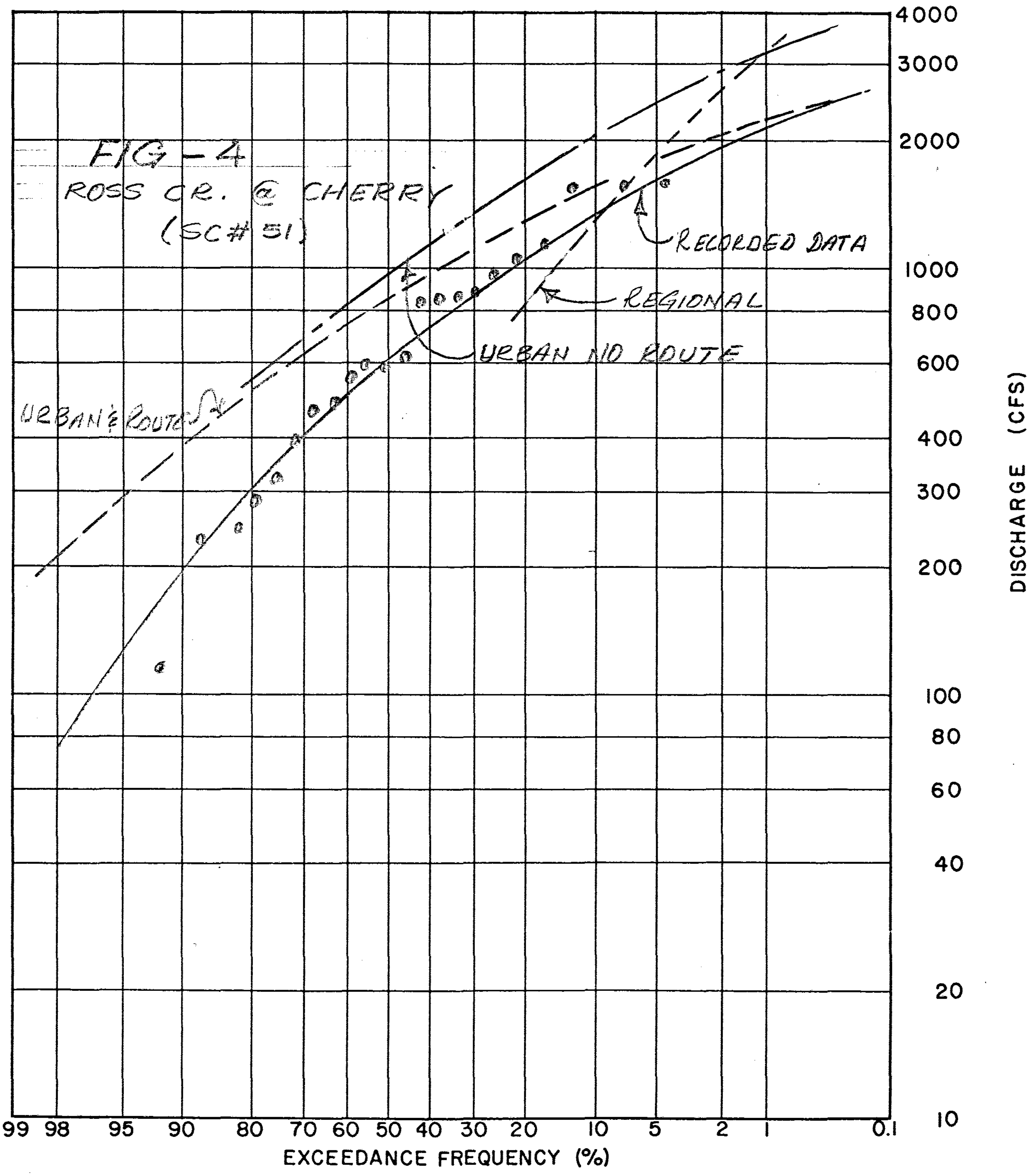


FIG-4
ROSS CR. @ CHERRY
(SC# 51)

In Figure 4, the application of the regional regression equations generated a frequency curve that represents a complete rural setting. The curve obtained from the statistical analyses of recorded data represent a gradually urbanizing watershed. The rainfall - route curve represents the passage of urban water through the storm drain and, finally, the no-route curve represented free flow of urban water to the creek without the throttling effect of the storm drains. The first three curves crossed at points between the 10 and 20-year floods. This shows that, as far as the flood control facility is concerned, urbanizing a watershed would increase the more frequent floods (those having frequencies more than that used in the design of storm drains) while reducing the magnitude of the less frequent floods. It also shows that the no-route condition generated urban flows that are far larger than the rural (regional regression) flows. At flood levels that are equal to or less than the 1%, the urban flow were found to be equal to the rural ones.

Because the one percent and ten percent flows, generated from the rainfall-route condition, are the results of utilizing all the information, they were chosen to represent the design flows for Ross Creek.

Tables 4 and 5 list the 1% and 10% design flows at various locations.

Table-4

Final

1 % Route

```
***************************
C-1 VERSION DATED JAN 1973
DATED AUG 74
ANGE NO, 01
***************************
                        ROSS CREEK HYDROLOGY,  100 YR FLOOD        1981
```

Loss rates 30% and 5% for pervious and impervious parts respectively (See Area H).
Tcu & Ru are made equal to 0.27 and 0.1, and TcS & RS = 0.83 & 0.2 to avoid routing twice.
Storm Drains capacities of Area B & H2 are increased to reflect overbanking condition

```
                                                 JOB SPECIFICATION
                                  NQ     NHR    NMIN   IDAY     IHR   IMIN METRC    IPLT   IPRT NSTAN
                                 130       0      15      0       0      0     0       2      0     0
                                                      JOPER      NWT
                                                          3        0


           **********          **********          **********          **********          **********

                                              SUB-AREA RUNOFF COMPUTATION

                      RUNOFF OF SHANNON CREEK @ BLOSSOM HILL (A1@1) STA,#21             1

                                  ISTAQ     ICOMP     IECON     ITAPE      JPLT      JPRT     INAME
                                      1         0         0         0         0         0         1

                                                  HYDROGRAPH DATA
                                             33 0,0681 0,0465      108,
                                             34 0,0727 0,0511      110,
                                             35 0,0734 0,0518      113,
                                             36 0,0780 0,0564      117,
                                             37 0,0512 0,0296      112,
                                             38 0,0765 0,0549      107,
                                             39 0,0535 0,0319      105,
                                             40 0,0788 0,0572      105,
                                             41 0,0597 0,0381      107,
                                             42 0,0650 0,0434      103,
                                             43 0,0688 0,0472      104,
                                             44 0,0620 0,0404      103,
                                             45 0,0719 0,0503      104,
                                             46 0,0841 0,0625      113,
                                             47 0,0727 0,0511      119,
                                             48 0,0589 0,0373      114,
                                             49 0,0750 0,0534      111,
                                 PEAK      6-HOUR     24-HOUR     72-HOUR        AREA
HYDROGRAPH AT            1       441.        223.        129.        107.        0.90  SANNON CR. (A1 @ BLOSSOM Hill)
HYDROGRAPH AT            1       584.        314.        183.        151.        1.09  UPPER ROSS (A2 〃   〃   )
HYDROGRAPH AT            1       486.        239.        145.        121.        0.91  〃     〃  (A3 〃   〃   〃)
 3 COMBINED              1      1526.        872.        517.        428.        2.90
HYDROGRAPH AT            1      1170.        663.        399.        322.        2.90   Ross CR. @ BLOSSOM Hill (STA.
ROUTED TO                2       945.        661.        399.        320.        2.90
HYDROGRAPH AT            2       402.        202.        127.        108.        0.71
HYDROGRAPH AT            2       223.        110.         62.         52.        0.47
 2 COMBINED              2       592.        311.        189.        159.        1.18
ROUTED TO                2       266.        242.        184.        158.        1.18
 2 COMBINED              2      1210.        899.        582.        478.        4.08   Ross @ UNION
ROUTED TO                3      1168.        898.        581.        477.        4.08
HYDROGRAPH AT           31       380.        237.        142.        116.        1.04  LONG Hill @ Blossom Hill
ROUTED TO                3       356.        237.        142.        115.        1.04
HYDROGRAPH AT            3       322.        161.        101.         86.        0.60
HYDROGRAPH AT            3        90.         44.         25.         21.        0.20
 2 COMBINED              3       392.        206.        127.        107.        0.80
ROUTED TO                3       182.        166.        126.        106.        0.80
 2 COMBINED              3       537.        398.        267.        222.        1.84  LONG Hill U/s Ross
 2 COMBINED              3      1669.       1293.        848.        698.        5.92  Ross D/s LONG Hill @ HARWOO
HYDROGRAPH AT            4       432.        217.        136.        116.        0.79
HYDROGRAPH AT            4       119.         59.         33.         28.        0.26
 2 COMBINED              4       525.        275.        169.        143.        1.05
ROUTED TO                4       169.        167.        150.        135.        1.05
 2 COMBINED              4      1837.       1456.        996.        834.        6.97
HYDROGRAPH AT            4       169.         84.         53.         45.        0.32
HYDROGRAPH AT            4        35.         17.          9.          7.        0.08
 2 COMBINED              4       194.        102.         62.         52.        0.40
ROUTED TO                4        63.         63.         57.         51.        0.40
 2 COMBINED              4      1900.       1518.       1052.        885.        7.37   Ross @ CAMDEN
ROUTED TO                5      1862.       1516.       1052.        881.        7.37
HYDROGRAPH AT            5       233.        117.         73.         62.        0.47
HYDROGRAPH AT            5        83.         41.         23.         19.        0.20
 2 COMBINED              5       300.        157.         96.         82.        0.67
ROUTED TO                5        97.         96.         87.         78.        0.67
 2 COMBINED              5      1959.       1610.       1137.        959.        8.04
HYDROGRAPH AT            5       394.        198.        124.        105.        0.78
HYDROGRAPH AT            5       140.         69.         39.         32.        0.33
 2 COMBINED              5       508.        266.        163.        138.        1.11
ROUTED TO                5       162.        160.        145.        131.        1.11
 2 COMBINED              5      2120.       1769.       1281.       1090.        9.15  Ross @ MARIDIAN
ROUTED TO                6      2073.       1765.       1280.       1081.        9.15
HYDROGRAPH AT            6       384.        192.        121.        102.        0.81
HYDROGRAPH AT            6        48.         24.         13.         11.        0.12
 2 COMBINED              6       419.        216.        134.        114.        0.93
ROUTED TO                6       147.        146.        130.        113.        0.93
 2 COMBINED              6      2220.       1911.       1410.       1194.       10.08  R.. @ [illegible] (STA. 5)
```

Final

10 % Route

```
****************
 DATED JAN 1973


****************
       ROSS CREEK HYDROLOGY.   10 YR FLOOD       1981



                                        JOB SPECIFICATION
                      NQ    NHR   NMIN  IDAY    IHR   IMIN METRC   IPLT   IPRT NSTAN
                     130      0     15     0      0      0     0      0      0      0
                                          JOPER      NWT
                                              3        0



  **********         **********         **********         **********         **********

                                  SUB-AREA RUNOFF COMPUTATION

       RUNOFF OF SHANNON CREEK @ BLOSSOM HILL (A1@1) STA.#21              1

                       ISTAQ    ICOMP    IECON    ITAPE     JPLT     JPRT    INAME
                           1        0        0        0        0        0        1

                                        HYDROGRAPH DATA
         IHYDG      IUHG    TAREA     SNAP    TRSDA    TRSPC    RATIO   ISNOW    ISAME    LOCAL
             0         0     0.90     0.00     0.00     0.00    0.000       0        0        0

                                          PRECIP DATA
                                  NP    STORM      DAJ      DAK
                                  96     5.22     0.00     0.00
                                        PRECIP PATTERN
   0.40      0.35      0.35      0.47      0.53      0.60      0.60      0.62      0.53      0.59
   0.51      0.56      0.74      0.75      0.80      0.85      1.04      0.94      1.12      1.13
   0.92      0.80      0.90      0.88      0.84      0.76      0.82      0.72      1.03      0.82
   0.96      0.95      0.95      0.94      0.93      0.94      0.72      0.92      0.91      0.74
   0.93      0.82      0.86      0.68      0.94      0.85      0.89      0.92      0.91      0.78
   0.94      1.13      1.23      1.28      1.50      1.70      0.83      0.92      1.05      1.43
   1.56      1.56      1.69      1.93      1.62      1.17      1.74      2.06      2.60      3.18
   3.33      3.28      1.44      1.11      1.09      1.06      1.07      1.10      1.17      0.89
   0.93      0.89      0.82      1.06      0.52      1.04      0.85      1.06      0.86      0.86
   0.88      0.85      0.72      0.79      0.94      0.84
```

```
                              PEAK     6-HOUR    24-HOUR    72-HOUR      AREA
HYDROGRAPH AT          1      223.       123.        64.        52.      0.90  SHANNON CR. (A1 @ Blossom Hill)
HYDROGRAPH AT          1      310.       182.        97.        79.      1.09  UPPER ROSS (A2 "   "   ")
HYDROGRAPH AT          1      251.       128.        75.        63.      0.91   "    "  (A3 "   "   ")
 3 COMBINED            1     1008.       541.       296.       244.      2.90
HYDROGRAPH AT          1      583.       368.       208.       168.      2.90  Ross CR. @ Blossom Hill (STA. 21)
ROUTED TO              2      511.       367.       208.       167.      2.90
HYDROGRAPH AT          2      275.       138.        85.        72.      0.71
HYDROGRAPH AT          2      141.        65.        33.        26.      0.47
 2 COMBINED            2      413.       202.       117.        99.      1.18
ROUTED TO              2      190.       170.       117.        98.      1.18
 2 COMBINED            2      701.       536.       325.       265.      4.08  Ross @ UNION
ROUTED TO              3      685.       535.       325.       264.      4.08
HYDROGRAPH AT         31      189.       114.        64.        52.      1.04  LONE HILL @ Blossom Hill
ROUTED TO              3      178.       114.        64.        52.      1.04
HYDROGRAPH AT          3      217.       109.        67.        57.      0.60
HYDROGRAPH AT          3       56.        26.        13.        10.      0.20
 2 COMBINED            3      272.       134.        80.        67.      0.80
ROUTED TO              3      140.       123.        80.        67.      0.80
 2 COMBINED            3      318.       236.       144.       119.      1.84 LONE Hill U/s Ross
 2 COMBINED            3      988.       769.       468.       384.      5.92 ROSS D/S LONE HILL CR. @ HARWOOD.
HYDROGRAPH AT          4      295.       148.        91.        77.      0.79
HYDROGRAPH AT          4       75.        35.        17.        14.      0.26
 2 COMBINED            4      369.       182.       108.        92.      1.05
ROUTED TO              4      143.       139.       108.        91.      1.05
 2 COMBINED            4     1131.       908.       576.       474.      6.97
HYDROGRAPH AT          4      115.        58.        36.        30.      0.32
HYDROGRAPH AT          4       23.        11.         5.         4.      0.08
 2 COMBINED            4      137.        68.        41.        34.      0.40
ROUTED TO              4       57.        55.        40.        34.      0.40
 2 COMBINED            4     1188.       963.       616.       508.      7.37 ROSS @ CAMDEN
ROUTED TO              5     1166.       961.       616.       506.      7.37
HYDROGRAPH AT          5      159.        80.        49.        42.      0.47
HYDROGRAPH AT          5       52.        24.        12.        10.      0.20
 2 COMBINED            5      211.       104.        61.        51.      0.67
ROUTED TO              5       84.        82.        61.        51.      0.67
 2 COMBINED            5     1250.      1043.       677.       557.      8.04
HYDROGRAPH AT          5      270.       136.        84.        71.      0.78
HYDROGRAPH AT          5       89.        41.        21.        17.      0.33
 2 COMBINED            5      358.       176.       104.        88.      1.11
ROUTED TO              5      140.       137.       104.        87.      1.11
 2 COMBINED            5     1390.      1179.       780.       644.      9.15  ROSS @ MERIDIAN
ROUTED TO              6     1365.      1176.       780.       641.      9.15
HYDROGRAPH AT          6      262.       131.        81.        69.      0.81
HYDROGRAPH AT          6       30.        14.         7.         6.      0.12
 2 COMBINED            6      292.       145.        88.        74.      0.93
ROUTED TO              6      139.       131.        88.        74.      0.93
 2 COMBINED            6     1503.      1303.       867.       715.     10.08
```